QUALITY INSPECTION SYSTEM FOR CANNED PINEAPPLE

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ABSTRACT

The color image processing plays an important role in many of the applications nowadays. The variety image processing technique and the excellent performance is enhancing the human life to become more qualitative. This Quality Inspection System is mainly concern on the software development with MATLAB. The Quality Inspection System is helping LPNM to verify the quality of the cans of pineapple of the factory. It is more to manage quality control and health regulation at registered pineapple factory. The cans of pineapple will pick randomly to do the quality test. This system will scan and detect the yellowish of the pineapple in the cans via camera. The system will pass and certify only if the yellowish of the pineapple pass the standard of LPNM. After pass through all the testing, LPNM will certify and allow the cans of pineapple export to other countries. Through the final year project, it can be concluded that image processing technique can be implemented to detect grades for canned pineapple. The Quality Inspection System able to display the grades through a pop up window.

ABSTRAK

Pemprosesan imej berwarna memainkan peranan yang amat penting dalam pelbagai applikasi pada masa kini. Teknik pemprosesan imej yang berbagai-bagai dan pancapaiannya yang cemerlang telah mengkayakan kehidupan manusia. Sistem ini tertumpu kepada perkembangan perisian ke atas applikasi pemprosesan imej dengan Matlab. Kualiti Sistem Pemeriksaan ini akan membantu LPNM untuk mengesahkan kualiti tin nanas dari kilang. Sistem ini akan menetapkan kawalan kualiti dan peraturan-peraturan kesihatan dari kilang nanas berdaftar. Tin nanas akan dipilih secara rawak untuk melakukan ujian kualiti. Sistem ini akan mengimbas dan mengesan kekuningan nanas dalam tin melalui kamera. Sistem akan melancar dan menyertifikasi jika kekuningan nanas lulus piawai LPNM. Setelah melalui semua ujian, LPNM akan menyertifikasi dan mengizinkan eksport tin nanas ke negara lain. Melalui projek ini, boleh disimpulkan bahawa teknik pemprosesan imej dapat digunakan untuk mengesan kelas untuk tin nanas. Kualiti Sistem Pemeriksaan boleh memaparkan kelas nanas.

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INTRODUCTION

1.1 Project Background

Quality control is a process by which entities review the quality of all factors involved in a production line. This is very essential to ensure the quality of products is fulfilling the specification and qualification. Visual inspection is one of the methods for quality control purpose. Visual inspection means inspection of structures and equipment by using either or all of human senses such as vision, smell, touch and hearing.

The quality inspection system is developed to help LPNM to verify the quality of the cans of pineapple of the factory. It is more to manage quality control and health regulation at registered pineapple factory. The cans of pineapple will pick randomly to do the quality test. This system will scan and detect the yellowish of the pineapple in the cans via camera. The system will pass and certify only if the yellowish of the pineapple pass the standard of LPNM. After pass through all the testing, LPNM will certify and allow the cans of pineapple export to other countries.

1.2 Problem Statement

The standard of grade for pineapple is uncertain. This is due to the relevant authority determine the grade manually. They grade the pineapple based on their experience. The database from LPNM for grading the pineapple is not complete due to not specific software or machine to grade the pineapple properly.

1.3 Objective

The objective of this project is to develop a system to test the quality of canned pineapple, standardize for color detection and use MATLAB for the system development.

1.4 Scopes of Project

The scopes of project are to develop a complete system to undergo color detection before grading the canned pineapple. The system has to able to analysis the yellowish of the pineapple. The whole system will undergoes real time analysis.

CHAPTER 2

THEORY AND LITERATURE REVIEWS

2.1 Introduction

This chapter includes the review of the fundamentals for various images, RGB color space and relevant mathematics. Projects implemented with color image processing and machine vision system are discussed.

2.2 Images Type

The MATLAB function toolboxes have supports four types of images, which are intensity images, binary images, indexed images and RGB images.

2.2.1 Intensity Images

Intensity image is a data matrix whose values have been scaled to represent the intensities. When the elements of an intensity image are of class uint8, it has the values in the range of [0, 255] based on the calculation of 2^8; class uint16, it has the range of [0, 65535] based on the calculation of 2^16. If the images of class double, the values are floating-point numbers. Figure 2.1 below shows the Intensity image.

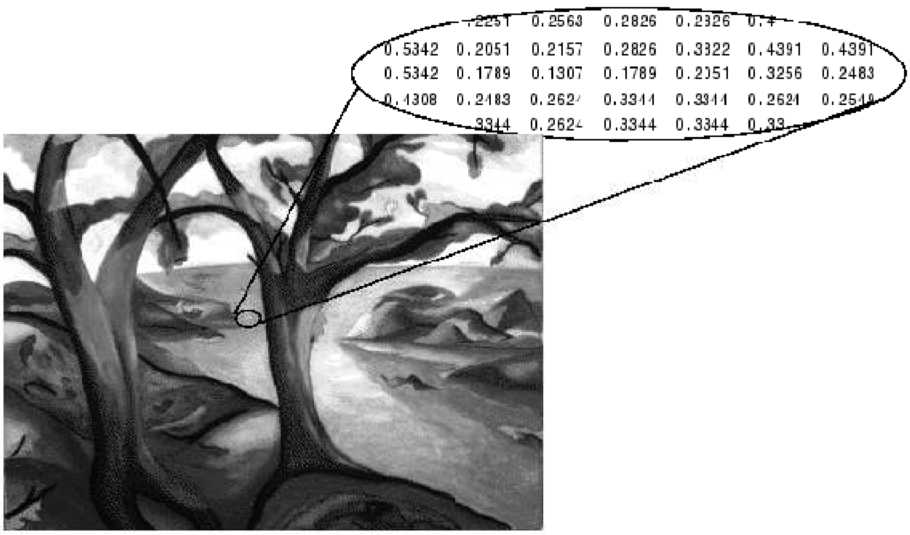

Figure 2.1 Intensity Image.

2.2.2 Binary Images

A binary number in Matlab is represented by 0s and 1s. Normally, function logical is applied to convert numerical array to binary. If A is a numeric array consisting of 0s and 1s, the logical B array will be create as B = logical (A). Figure 2.2 below shows the Binary image.

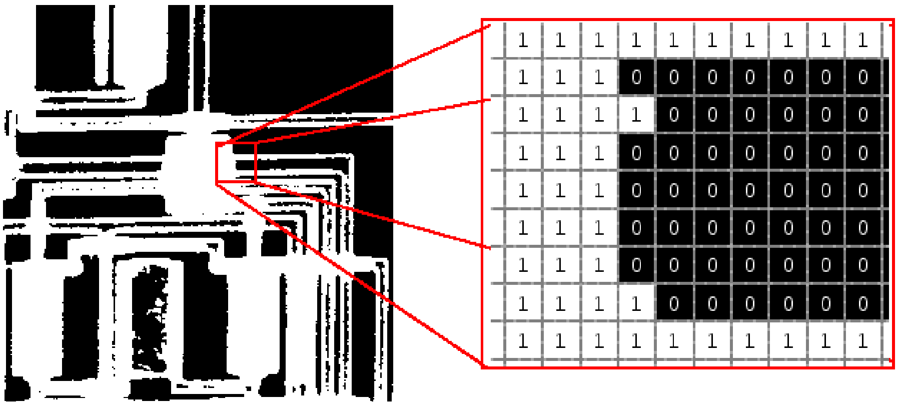

Figure 2.2 Binary Images

2.2.3 RGB Images

RGB is the 3 basic color pixels corresponding to Red, Green and Blue. A RGB color Image is an M x N x 3 array of color pixels. If an RGB image is of class double, the range of value is [0, 1]. Similarly, there are classes uint8 or uint16 for the range of [0, 255] based on the calculation of 2^8 and [0, 65535] based on the calculation of 2^16. Figure 2.3 below shows the RGB image.

Figure 2.3 RGB Image.

2.3 Basic RGB Color Space

The RGB color space is the most frequently used color space in the term of image processing. This color space is the basic one, as normally color camera, scanners and displays are most often provided with direct RGB signal input or output. The color gamut in RGB space forms a cube as shown in Figure 2.4. Each color, which is described and displayed by its RGB components, is represented by a point and can be found either on the surface or inside the cube. Because the image uses 8 bits per primary color channel, the range per primary is 0 to 255 (2^8=256).

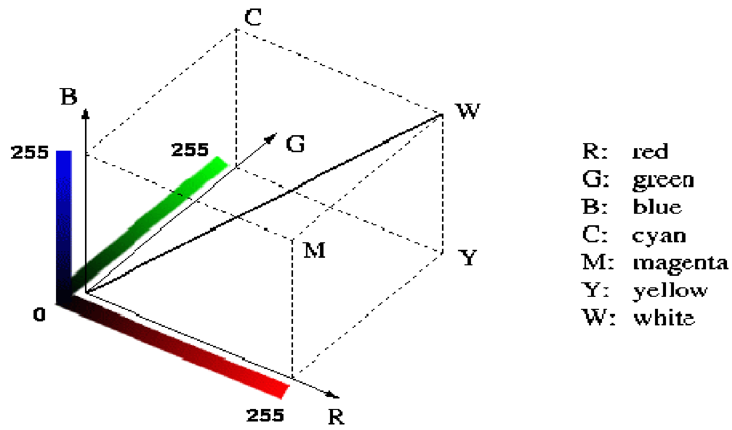

Figure 2.4 RGB color cube for a uint8 image.

The values of red, green and blue are displayed and represented at each axis of the cube in the range [0,255]. The red axis, labeled R, shows the associated color scale beneath it. The green and blue axes are illustrated similarly. The color's intensity is represented by the values between 0 and 255. Colors act like vector in the term of color space. They can be combined by addition and subtraction to obtain other colors in the cube. Thus, black color or the origin of the cube, is represented by $0_R\,0_G\,0_B$. The far corner from the origin is the sum of the highest intensities of red, green, and blue, or $255_R\,255_G\,255_B$, which is white color. All grey colors are placed on the main diagonal of this cube from black (R=G=B=0) to white (R=G=B=255).

RGB components in an image are proportional to the amount of light incident on the scene represented by the image. In order to eliminate the influence of illumination intensity, so called Chromaticity coordinates.

$$r = \frac{R}{R + G + B}$$

$$g = \frac{G}{R + G + B}$$

$$b = \frac{B}{R + G + B} = 1 - r - g$$

2.4 Applications

The measurement systems based on images can apply in various kinds of scientific areas. Besides that, in various industrial, medical and agricultural environments the applications are rapidly growing. The classification and detection in the term of color images is essential for many applications, such as image matching, image segmentation, visual tracking and object recognition in the fields of computer vision and image processing.

2.4.1 FITTING A PINEAPPLE MODEL FOR AUTOMATIC MATURITY GRADING

In this paper, we present a pineapple skin model and a method to fit the model. Our main application of the model is for automatic maturity grading of pineapples in canned pineapple industry. The model consists of two subparts: Phyllotaxis and pineapple scale models. The Phyllotaxis model represents the spiral arrangement of pineapple-scales, which is a growing pattern of the fruit. It includes a string of scale-model cells. The scale model includes boundary, internal area and petal part of scale. Modified snake algorithm is used to construct the structure model while Active Shape Model (ASM) is applied to each scale. The model can accurately fit to pineapple skins in our experiment and classification features of the fruit can be extracted.

Researches in food engineering [1] suggested that their maturity, which is closely related to their color and texture, can be identified by their physical properties and external appearance. This agrees with the way pineapple grading experts employ to classify pineapples for commercial uses. Currently the grading process in most manufacturers is done by human inspectors. They rely on visual appearance of the fruit on transmission belt. The external appearance used to determine the maturity includes shape, color, texture and relative locations of their scales [2]. Examples are color in internal area of the scale and ratio of scale sizes between lower and higher spiral levels.

2.4.2 Skin Detection using Color Pixel Classification with Application to Face Detection: A Comparative Study

This paper presents a comprehensive study of the pixel-based skin color detection techniques. Two main issues of the skin detection are the selection of the best color space and skin color pixel classification algorithm. A large set of XM2VTS face database is used to examine whether the selection of color space can enhance the compactness of the skin class and discriminability between skin and non-skin class in thirteen color spaces and six different skin color pixel classification algorithms. The results show that 1) the selection of the color space can improve the skin classification performance 2) the segmentation performance degrades only when chrominance information is used for classification 3) Bayesian classifier is found to perform better as compared to other classification algorithms. Piecewise linear decision boundary classifier algorithm outperforms all the other skin classification algorithms when it is used for images with good illumination conditions.

Detecting human skin regions in an image is the paramount importance in many computer vision areas like face detection, face recognition, and video surveillance [3], [4]. The skin detection techniques involve the classification of each image pixel into skin and non-skin categories on the basis of pixel color [5], [6]. The rationale behind this approach is that the human skin has very consistent colors which are distinct from the colors of other objects. Color is a powerful cue that can be used as a first step in skin detection because of its advantages: low computational cost, robustness against illumination changing and geometrical transformation.

When building a system that uses skin color as a feature for face detection, two issues must be addressed: what color space to select, which color skin classification algorithm to use. This paper covers both of the questions. In the past few years, a number of comparative studies of skin color pixel classification have been reported. Jones and Rehg [4] used the Bayesian classifier with the histogram technique for skin detection. Terrillon et al. [7] compared Gaussian and Gaussian mixture models across nine chrominance spaces. Greenspan et al. [8] compared skin segmentation in eight color spaces.

In this paper, a comprehensive study of two important issues of the color pixel classification approach to skin segmentation, namely selection of color spaces and classification algorithm are presented. Thirteen different color spaces and six different color pixel classification algorithms are examined for skin detection. To support this study, a large set of XM2VTS image database consisting of more than 400 color images together with manually prepared ground-truth for skin segmentation and face detection were used. The paper is organized as follows. Section 2 is devoted to different skin classifications techniques like color representations and color pixel classification algorithms. The results of our analysis and comparison are presented in Section 3, and conclusions are given in Section 4.

2.4.3 Recognition and Extraction Algorithm Design for Defect Characteristics of Armorplate Flaw Detection Image

Aiming at the detection image of strip steel which rolled on the 15mm plate production line in a steel plant, the defect characteristics recognition and extraction algorithm had been analyzed and designed, based on the computer image processing and pattern recognition theory. And the corresponding defect characteristics recognition and processing program had been programmed by vc++6.0 computer language. In the paper, the 8 direction pixel gray value search algorithm had been compiled based on the computer image color grading theory firstly, then to extract every gray level pixel information of the armor-plate detection image, and to carry out the corresponding every gray level pixel distribution probability statistic. Based on the statistical results, the two-dimension histogram Fish evaluation function algorithm for the armor-plate CCD image processing had been designed, and the result of practical application shows that the defect characteristics recognition system which programmed based on the algorithm ahead can accurately recognize and extract the defect characteristics data from the armor-plate rolled detection image, and can effectively satisfy the industrial production requirement of plate rolled.

2.4.4 Machine Grading and Blemish Detection in Apples

Five classifiers including the K-means, Fuzzy c-means, K-nearest neighbour, Multi-Layer Perception Neural Network and Probabilistic Neural Network classifiers are compared for application to color grade classification and detection of bruising of

Granny Smith apples. A number of suitable discriminate features are determined heuristically for the categorization of four classes including: high grade fruit, high grade fruit with bruising or blemishes, off-grade hit , and off-grade fruit with bruising or blemishes. Robust features based on intensity statistics are extracted from enhanced monochrome images produced by special transformation from original RGB images. The best of the five classifiers using the optimal feature set, is shown to outperform human graders viewing the same images.

This paper describes a vision system composed of a color image processing algorithm coupled with a classifier designed to perform both grading and blemish detection of Granny Smith apples. The algorithm first extracts the apple area from the image background and then a feature vector is created from the color image of the apple surface before passing it to the classifier. The design uses localized techniques in the preprocessing stage combined with a global feature extraction algorithm.

2.4.5 Parquet Sorting and Grading Based on Color and Texture Analyses

In this paper a computer vision algorithm for automatic parquet slab sorting is described, as a part of a real time automatic parquet slab sorting system. Various computer vision algorithms and methods for automatic visual inspection and automatic classification have been analyzed. Developed algorithm consists of three main stages: color analysis, texture analysis and defects detection. The color analysis is based on the percentile values obtained from the cumulative histogram of the image and texture